

# UNIFIED FACILITIES CRITERIA (UFC)

## TELECOMMUNICATIONS INTERIOR INFRASTRUCTURE PLANNING AND DESIGN



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UNIFIED FACILITIES CRITERIA (UFC)

**TELECOMMUNICATIONS  
INTERIOR INFRASTRUCTURE**

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U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by \1\ ... /1/)

<b>Change No.</b>	<b>Date</b>	<b>Location</b>
1	1 Jun 2016	Updated references 2-2; defined fiber optic adapter and connector requirements 2-6.1.3.1; defined CATV cabling requirements 2-8.2; updated URL link 4-2.2; clarified Army outside plant requirements 4-2.6.4. Modified paragraphs 2-8.1 and 2-9.1.

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**This UFC supersedes MIL-HDBK-1012/3, dated MAY 1996, UFC 3-580-10, and UFC 3-580-01 dated June 2007.**

## FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the Department of Defense (DoD) Field Activities in accordance with [USD \(AT&L\) Memorandum](#) dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

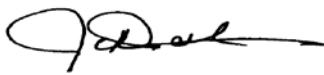
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## UNIFIED FACILITIES CRITERIA (UFC) REVISION SUMMARY SHEET

**Document:** UFC 3-580-01, Telecommunications Interior Infrastructure

**Superseding:** UFC 3-580-01 Telecommunications Building Cabling Systems Planning and Design, dated 22 June 2007; UFC 3-580-10 Design: Navy and Marine Corps Intranet (NMCI) Standard Construction Practices dated 14 July 2004; Installation Information Infrastructure Architecture (I3A) dated February 2010; Engineering Technical Letter (ETL) 02-12 dated 27 June 2002; and MIL-HDBK-1012/3, dated May 1996.

**Description:** This UFC document provides requirements for designing and implementing interior telecommunications infrastructure for military construction. This infrastructure typically includes telecommunications spaces, pathways, cabling and interconnecting components.

### Reasons for Document:

The design of interior telecommunications infrastructure is a specialized technical area. This UFC provides guidance to those parties tasked with implementing existing and emerging interior telecommunications infrastructure requirements. The basic requirements follow industry standards. Due to service specific unique operating requirements and existing infrastructure and topology, this document includes a chapter for each service.

### Impact:

- Creates a single source reference for the planning, design and construction of interior telecommunications infrastructure which allows planners, engineers and installers to standardize on requirements.
- Promotes efficient use of available funds and resources for interior telecommunications infrastructure.

### Unification Issues

Service specific requirements are detailed in Chapters 3, 4, 5, and 6.

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## CHAPTER 1 INTRODUCTION

### 1-1 PURPOSE AND SCOPE

This UFC provides requirements for the planning, design, and construction of interior telecommunications infrastructure. Requirements common to all services are contained in Chapters 1 and 2 of this document. Service specific requirements are identified in Chapters 3, 4, 5, and 6.

The scope includes telecommunications spaces, pathways, cabling and interconnecting components necessary to support the infrastructure for voice, data and video systems. "Video systems" includes the necessary infrastructure for Closed Circuit Television (CCTV), Community Antenna Television (CATV), generally referred to as Cable TV, and Video Teleconferencing (VTC). This UFC does not address the design and specifics of the technologies that utilize the telecommunications infrastructure.

### 1-2 APPLICABILITY

This UFC applies to all interior telecommunications infrastructure planning, design and installation in new or existing facilities. Waivers and exemptions must comply with the process identified in MIL-STD 3007.

### 1-3 GENERAL BUILDING REQUIREMENTS

Comply with UFC 1-200-01, General Building Requirements. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

### 1-4 GOVERNING CRITERIA FOR ELECTRICAL SYSTEMS

UFC 3-501-01 provides the governing criteria for electrical systems, explains the delineation between the different electrical-related UFCs, and refers to UFC 3-520-01 for interior electrical system requirements.

### 1-5 MODERNIZATION WITHIN EXISTING FACILITIES

Modernization of telecommunications systems within existing facilities solely for the purpose of meeting design criteria in this UFC is not required.

### 1-6 REFERENCES

Appendix A contains a list of references used in this document. The publication date of the code or standard is not included in this document. In general, the latest available issuance of the reference is used.

1-7            **ACTIVITY SPECIFIC TELECOMMUNICATIONS MANAGERS**

Throughout this document, the term “telecommunications manager” refers to the following:

- For Army, the Network Enterprise Center (NEC).
- For Navy, refers to a group of individuals with responsibilities as shown in Figure 5-1.
- For Marine Corps, the G6.
- For Air Force, the Base Communications Officer (BCO).

1-8            **GLOSSARY.**

The glossary at the end of this document contains acronyms, abbreviations, and terms.

## CHAPTER 2 DESIGN REQUIREMENTS

### 2-1 GENERAL GUIDANCE

Design interior telecommunications infrastructure to meet the needs of the activity and supporting facilities in accordance with this document. A/E contractor generated final drawings and specifications for design-bid-build and design-build projects must be stamped by a BICSI Registered Communications Distribution Designer (RCDD).

*Note: Design and construction may be concurrent efforts in Design-Build projects, and multiple phases of construction may be approved. Therefore, the final documents for each construction phase must be stamped.*

#### 2-1.1 Government-Designed Projects

On government-designed projects (in-house design) the government designer must:

- Obtain the approval of the service appointed telecommunications agent, prior to bid, in accordance with regulations, policies, memorandums, and guidance.
- Ensure that the bid documents require an RCDD stamp on the contractor's telecommunications shop drawings submitted for approval.

#### 2-1.2 Small Scale Projects

Small scale projects limited to adding work area outlets from existing telecommunications rooms do not require an RCDD stamp provided the work is being accomplished under the technical authority of an RCDD or the government telecommunications manager.

### 2-2 CLASSIFIED INFRASTRUCTURE

Classified Infrastructure is any infrastructure that is used to transmit unencrypted classified National Security Information (NSI). Examples would be the infrastructure to support classified networks such as Secret Internet Protocol Router Network (SIPRNET) and Joint Worldwide Intelligence Communications System (JWICS).

Coordinate the design of classified telecommunications infrastructure with the telecommunications manager and the Certified Tempest Technical Authority (CTTA) responsible for that area. The following documents may be applicable:

- CNSSAM TEMPEST/1-13 (FOUO); defines the RED/BLACK installation guidance to consider during design and installation, and provides potential solutions \1\
- CNSSI 7003 (U); provides guidance on Protected Distribution Systems. /1/

### 2-3 SYSTEM OVERVIEW

Provide a complete, standards based, flexible telecommunications design including telecommunications spaces, pathways, outlets, connectors, cabling, grounding, bonding, and static protection in accordance with the following paragraphs.

## 2-4 TELECOMMUNICATIONS SPACES

### 2-4.1 Types of Spaces

Provide telecommunications spaces in accordance with Telecommunications Industry Association TIA-569-C. Refer to Figure 2-1.

*Note: This UFC utilizes commercial terminology for spaces in accordance with the TIA-569-C Errata sheet (e.g. Telecommunications Room, Equipment Room versus Distributor Room A and B, and Telecommunications Enclosure versus Distributor Enclosure).*

#### 2-4.1.1 Telecommunications Entrance Facility (EF)

The entrance facility (EF) is defined as the space housing the point of entrance of the telecommunications service. The EF is also the space where the inter-building backbone and intra-building backbone facilities join. For this document, the term backbone refers to intra-building backbone unless specifically designated otherwise. Telecommunication-related antenna entrances and electronic equipment may also be located in the EF. The demarcation point between the outside plant (OSP) cabling and the inside plant distribution cabling is known as the building entrance terminal (BET).

#### 2-4.1.2 Telecommunications Room (TR)

A telecommunications room (TR) is defined as an architectural space designed to contain telecommunications equipment, cable terminations, and cross connect cabling. It contains the telecommunications equipment for connecting the horizontal cabling to the backbone cabling system. The TR may also function as the telecommunications entrance facility.

#### 2-4.1.3 Equipment Room (ER)

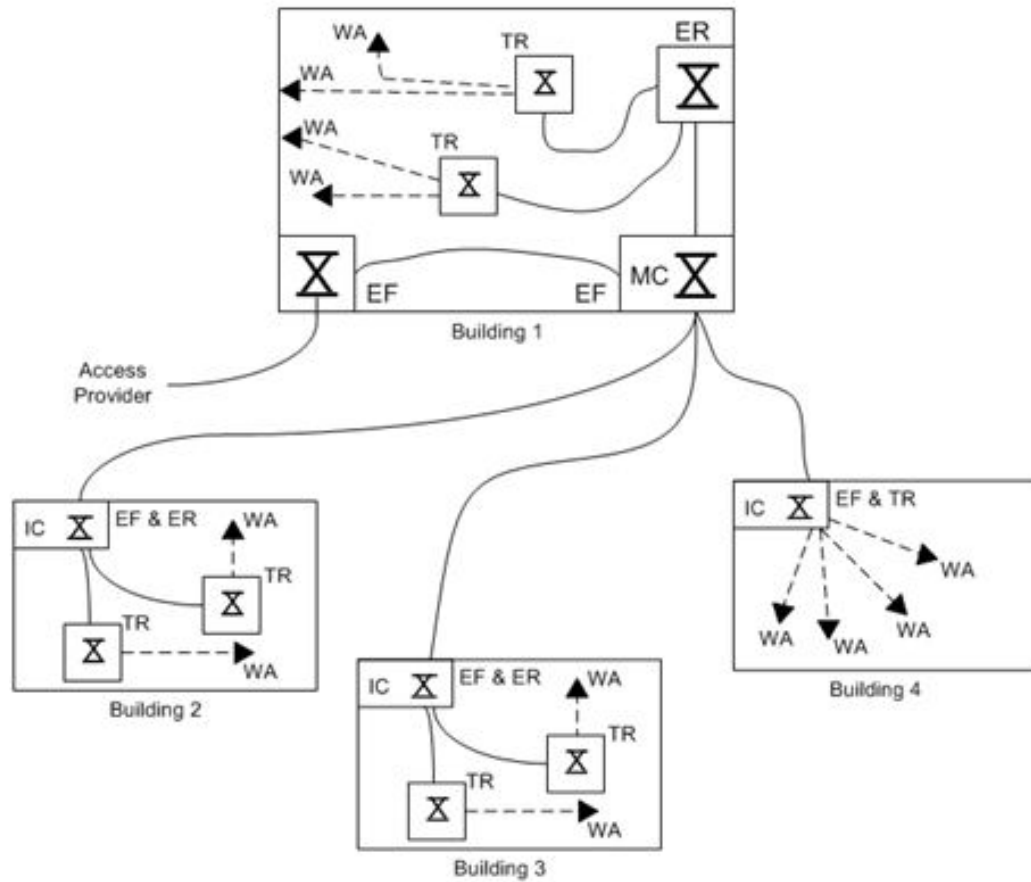
An equipment room (ER) is defined as an environmentally controlled, centralized space for telecommunications equipment that usually houses a main or intermediate cross-connect. Any or all of the functions of a telecommunications room or entrance facility may be provided by an equipment room.

#### 2-4.1.4 Telecommunications Enclosure (TE)

A telecommunications enclosure (TE) is defined as a case or housing for telecommunications equipment, cable terminations, and cross-connect cabling.

Although TEs serve much in the same capacity as that of a TR, a TE must not replace a TR. The TE is also referred to as a Distributor Enclosure in TIA-569-C. TEs must meet the requirements for Distributor Enclosures in TIA-569-C.

Figure 2-1 – Telecommunications Spaces and Cabling



Notes

1. This figure is not meant to be an all-inclusive representation of the telecommunications cabling system and is provided only as a typical example.
2. All cross-connects located in the telecommunications rooms (TRs) in this figure are horizontal cross-connects (HCs).
3. The equipment room (ER) for the point-of presence (POP) would be connected to the access provider as in Building 1 in the example.
4. In some cases an ER may contain the EF and serve as a TR. The TR may also contain the EF.

Legend	
Entrance Facility .....	EF
Equipment Room.....	ER
Intermediate cross-connect.....	IC
Main cross-connect.....	MC
Telecommunications Room.....	TR
Work Area .....	WA
Telecommunications Outlet.....	▶
Cross-connect .....	⊗
Backbone Cabling	—————
Horizontal Cabling	- - - - -

## 2-4.2 Architectural Considerations

### 2-4.2.1 Location and Access

Locate telecommunications spaces central to the areas they serve and in such a manner that the maximum cable length from the patch panel through the structured cabling system to the furthest outlet does not exceed 295 feet (90 m). Telecommunications spaces must be dedicated spaces not shared with other non-telecommunications functions (i.e., electrical rooms, mechanical rooms, plumbing, etc.). When designing telecommunications spaces, avoid locations that are restricted by building components that may limit expansion such as elevators, outside walls, or other fixed building walls. Locate spaces in an accessible area of the building (e.g. common hallway) but limit access to personnel having a telecommunications requirement or mission. Accessibility for the delivery of equipment such as network switches, equipment racks and cabinets must be provided. Locate the telecommunications space away from sources of electromagnetic interference or design the space to mitigate the effects of this interference. Give special attention to electrical power supply transformers, motors and generators, X-ray equipment, and radio or radar transmitters.

In renovation projects, avoid rooms containing transformers, air handling units, and similar equipment types if at all possible. If shared facilities cannot be avoided, comply with TIA-569-C and maintain proper electrical/telecommunications cable separations and provide working clearances per the National Electrical Code (NEC).

### 2-4.2.2 Sizing and Quantity

Size ERs in accordance with TIA-568-C-1.1. Size each TR in accordance with TIA-568-C-1.1, except that the minimum TR size for DoD buildings is 10 feet x 8 feet (3m x 2.4m). Generally, the TR should be sized to approximately 1.1 percent of the area it serves. For example, a 10,000 sq feet (929 sq m) area should be served by a minimum of one 10 ft x 11 feet (3 m x 3.4 m) TR. Divide large floor areas into “serving areas” with TRs for each serving area. Each serving area can be no larger than 10,000 sq feet (929 sq m) as stipulated in TIA-568-C-1.1. TR sizing, power, and HVAC requirements may be substantially impacted if additional systems are required in the TR. Consult with the architectural designer or facilities engineer when additional systems requirements (audio visual systems, servers, disk storage arrays, etc.) are integrated into the TR. Consider utilizing an ER for areas that exceed 10,000 sq feet (929 sq m) or buildings that house substantial Information Technology (IT) electronics. Provide a minimum of one TR per floor. Provide additional rooms when the floor area is greater than 10,000 sq feet (929 sq m) and or the total cable distance to the outlet is over 295 feet (90 m).

*Note: One TR may suffice for multi-story buildings in unique instances. Refer to section on Multi-Story Buildings below.*

Provide adequate space in TRs to facilitate tenant owned data and telecommunications systems, and other low voltage systems such as fire alarm, CATV, CCTV, and electronic security systems (ESS). Support equipment requirements in tenant installed freestanding cabinets or racks. Total TR space as a percentage of the building's

area must be scaled upward, to reflect the increased number of circuits in buildings with more than the standard number of circuits to each workspace.

#### 2-4.2.3 Floors, Walls, and Ceilings

For floors, walls, and ceilings in telecommunications spaces, meet the requirements in TIA-569-C. Do not install suspended ceilings in telecommunications spaces.

#### 2-4.2.4 Doors and Windows

Doors must meet the requirements for TRs in TIA-569-C and NFPA 101. Telecommunications spaces must not have windows or other architectural window equivalents.

#### 2-4.2.5 Multi-Story Buildings

Provide a minimum of one TR on each floor, sized in accordance with paragraph *Sizing and Quantity*. Serve all telecommunications outlets from the TR located on that floor. Vertically align TRs on successive floors. In the case of small and unique facilities one TR may be sufficient for the entire facility. These facilities include but are not limited to air traffic control towers, firing ranges, and range and weapons towers.

### 2-4.3 Utility Considerations

#### 2-4.3.1 Lighting

Design lighting for telecommunications spaces in accordance with UFC 3-530-01.

#### 2-4.3.2 Power

Provide a dedicated electrical branch circuit panelboard for each TR with the following minimum requirements: 120/208 volt, 3-phase or 120/240 volt, 1-phase, 24-(or 20 for 1-phase) space panel with a minimum 100 ampere (A) bus rated capacity. Feed all loads within the TR, except lighting, from this dedicated TR panel. Loads must include, but are not limited to, convenience receptacles, dedicated rack or cabinet receptacles, and HVAC systems (including exterior units for split systems). Provide 125V, 20A duplex convenience receptacles at 6 feet (1800mm) intervals on center around perimeter walls. When required by the Activity, provide an additional dedicated 125V, 20A circuit on the wall above the entry door for future electronic security system requirements. Coordinate with UFC 4-021-02, Electronic Security Systems (ESS).

At a minimum, provide two multi-outlet power strips in each rack or cabinet. One power strip must be 240 or 208V, 1-phase; the other must be 120V 1-phase. To minimize accidental shut-off, equip power strips with indicator lights, but no integral on/off switch. Provide matching (NEMA configured) twist-lock type receptacles fed from dedicated circuits in the TR panel to power each power strip. Install twist-lock receptacles above rack or cabinet, mounted to telecommunications cable tray or in ceiling space. As some rack or cabinet mounted equipment may require larger quantities of electrical power, the designer must consult with the local telecommunications group having jurisdiction to determine exact electrical power requirements for each TR.

#### 2-4.3.3 Heating, Ventilation, and Air Conditioning (HVAC)

Design telecommunication spaces to meet the HVAC requirements of TIA-569-C, including the Class B requirements for temperature and humidity as outlined in ASHRAE TC 9.9.

#### 2-4.3.4 Room Climate Control

Provide each TR with its own independent thermostat for climate control, capable of supporting year round ambient temperature control (24 hours/day, 365 days/year), to protect all installed electronic equipment as defined in TIA-569-C and TIA-569-C-1. The mechanical system designer of record must determine what type of system is necessary to meet the temperature and humidity requirements (e.g. zoned, dedicated, split core). Do not include heating and cooling systems on building time clocks or other temperature setback means for telecommunications spaces. Provide rooms with positive atmospheric pressure to minimize dust.

#### 2-4.3.5 Room Contaminants

Do not install information systems equipment in spaces where moisture, liquid or gaseous spillage, or other contaminants may be present as defined in TIA-569-C.

### 2-4.4 **Space Components**

For all information transport system (ITS) components, provide manufacturer's standard catalog products that conform to the latest published industry and technical society standards at the date of contract award. Do not use shop or field fabricated components that are not manufacturer's standard catalog products or that do not conform to the industry and technical society standards.

#### 2-4.4.1 Plywood Backboards

Provide backboards in accordance with TIA-569-C. Backboards must be fire-retardant-treated wood, bearing the manufacturer's stamp. If painted, the manufacturer's fire rated stamp must remain visible. Cover a minimum of two adjacent walls with backboards. When renovating an existing TR that does not have adequate space, size the backboard as large as possible to accommodate wall mounted equipment.

#### 2-4.4.2 Building Entrance Terminals

TIA-758 identifies two types of building entrance terminals (BET), protected and non-protected. Provide protected terminals in accordance with TIA-758-B. Equip protected terminals with modules to protect the inside plant cabling and equipment from power surges. Provide 110-type Insulation Displacement Connector (IDC) terminal blocks or cable stubs.

#### 2-4.4.3 Equipment Racks

Provide 19 inch (475mm) floor mounted equipment racks located at or near the center of the telecommunication spaces. A minimum of 36 inches (900 mm) space both in front and in back of the rack, measured from the equipment, and a minimum side clearance of 24



inches (600 mm) on at least one end of the rack or row of adjacent racks is required. Coordinate with the telecommunications manager to determine the space requirements for the government provided active equipment. Provide 25% spare capacity within each utilized rack. Provide one spare rack for every four utilized racks with a minimum of one spare rack per telecommunication space.

In existing facilities with narrow or crowded telecommunication spaces, equipment racks may be wall-mounted with the approval of the telecommunications manager. Refer to Figure 2-2.

#### 2-4.4.4 Equipment Cabinets

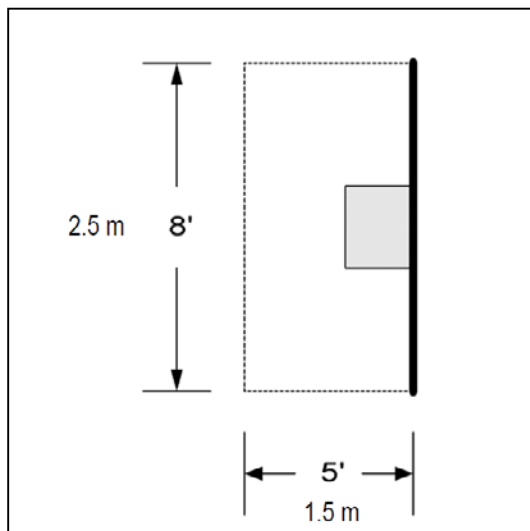
Provide equipment cabinets in lieu of racks:

- Where identified by service specific chapters.
- Where physical security is required, such as to mount secure or mission critical equipment.
- In circumstances where separately controlled access is desired (when multiple systems are collocated within the room).

Provide a minimum of 24 inch (600 mm) wide cabinets with cooling fans and internal rails to support 19 inch (475 mm) equipment. Locate cabinets at or near the center of the telecommunication spaces. A minimum space of 36 inches (900 mm), both in front and in back of the cabinet, and a minimum side clearance of 24 inches (600 mm) on at least one end of the cabinet or row of adjacent cabinets is required. Coordinate with the telecommunications manager to determine the space requirements for the government provided active equipment. Provide 25% spare capacity within each utilized cabinet. Provide one spare cabinet for every four utilized cabinets with a minimum of one spare cabinet per telecommunication space.

In existing facilities with narrow or crowded telecommunication spaces, equipment cabinets may be wall-mounted with the approval of the telecommunications manager. Where space is limited and clearances are affected, utilize swing out cabinets. Refer to Figure 2-2.

**Figure 2-2 – Wall Mounted or Floor Mounted Cabinet Clearance**



The workspace required around the cabinet/rack is still required even if the cabinet is mounted 6.5 feet (2.0 m) off the floor

#### 2-4.4.5 Horizontal and Vertical Cable Management

Install horizontal cable management panels above and below each patch panel. The required ratio of horizontal cable management to patch panels is 1:1. Provide vertical cable management between racks and at the end of racks when required to protect, manage, and organize cables. Vertical cable management panels should be a minimum of 6-inch (150mm) wide.

#### 2-4.4.6 Ladder and Wire Cable Tray

Utilize ladder type or welded wire cable tray in the telecommunication spaces to provide distribution between the plywood backboard, equipment racks, backbone conduits, and the distribution cable tray. Bond all metallic cable tray sections, and bond the cable tray system to the Telecommunications Grounding Busbar (TGB) or Telecommunications Main Grounding Busbar (TMGB).

#### 2-4.4.7 Unshielded Twisted Pair Patch Panels

For patch panels, use 8-position, 8-contact (8P8C) modular jacks, with rear mounted 110-type IDC terminations, category rated for the Unshielded Twisted Pair (UTP) system being installed, and arrange in rows or columns on 19-inch (475 mm) rack mounted panels. For small projects (i.e., fewer than ten users) 19-inch (475 mm) TIA category-qualified wall mounted block or backboard patch panels may be utilized. Provide T568A jack pin/pair configuration per TIA-568-C.0. T568B jack pin/pair configuration may only be used if required to maintain uniformity in an existing facility. Provide modular jacks that conform to the requirements of TIA-568-C, and rated for use with the installed cable plant. Install UTP patch panels in the same rack or in the rack immediately adjacent to the LAN equipment in order to minimize patch cord lengths. Provide a minimum spare capacity of 25 percent.

#### 2-4.4.8 Fiber Optic Patch Panels

Utilize patch panel connectors and couplers of the same type and configuration as used elsewhere in the system. Utilize duplex LC connectors on 19-inch (475 mm) rack mounted panels, unless otherwise directed. Provide a 3-foot (1-meter) slack loop of fiber within each panel, and include strain relief for cables within the panel. Provide proper termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-connection in all patch panels. Install fiber optic patch panels in the same rack or in the rack immediately adjacent to the LAN equipment in order to minimize patch cord lengths. Provide a minimum spare capacity of 25 percent.

In existing facilities, other connector types may be used to match the current infrastructure, with the approval of the telecommunications manager.

### 2-5 TELECOMMUNICATIONS PATHWAYS

A pathway is defined as a facility for the placement of telecommunications cable.

#### 2-5.1 Backbone Pathways

Backbone pathways (sometimes referred to as “vertical” pathways) are defined as structures that conceal, protect, support, and provide access to cables between telecommunications spaces. Examples of backbone pathways consist of conduit, sleeves, slots, cable tray, telecommunication spaces, and miscellaneous support facilities.

For intra-building backbone distribution, provide a minimum of two 4-inch (103 mm) conduits between TRs located on the same floor or pathway that provides equivalent capacity (e.g. cable tray installed to support backbone and horizontal distribution). In multistory buildings, provide a minimum of three 4-inch (103 mm) conduits, sleeves, or an equivalent sized slot between stacked TRs on successive floors in accordance with TIA-569-C.

#### 2-5.2 Horizontal Pathways

Horizontal pathways are defined as structures that conceal, protect, support, and provide access to cables between the telecommunications spaces and the work area outlet. Examples of horizontal pathways consist of conduit, cable trays, ceiling distribution, access floors, and non-continuous cable supports (J-hooks).

There are many methods to distribute cable from the telecommunications space to the work area and many buildings may require a combination of two or more types of pathway systems to meet all the distribution needs. The DoD required horizontal pathway is a ceiling distribution system employing a centralized cable tray system originating in the telecommunications space and continuing out into the serving areas. Utilize cable tray for horizontal distribution to the maximum extent possible (80 to 90 percent of the horizontal cable length). The remaining pathway to the work area outlet may be implemented in a variety of ways combining conduit, non-continuous cable supports, and stub-ups/outs.

### 2-5.2.1 Open Office Wiring

Open office wiring refers to work area spaces that are divided by modular furniture and partitions rather than by fixed walls. The electrical designer, the architect, and the interior designer must coordinate the layout of all furniture with electrical and telecommunications outlets during the design process. Furniture is typically specified and ordered when construction is nearing completion; therefore, if proper coordination has not occurred earlier in the design process, field interface problems will occur.

#### 2-5.2.1.1 Systems Furniture

Utilize architectural columns and perimeter walls to the maximum extent possible for telecommunications distribution to systems furniture workstations. In the absence of architectural columns or when systems furniture is located away from perimeter walls, utilize utility columns where permitted. Only if no other alternative exists, utilize under-floor conduits that are designed and installed in accordance with TIA-569-C. Include a spare conduit to under-floor outlet boxes for future expansion. Design systems furniture wiring connections in accordance with TIA-568-C and TIA-569-C.

#### 2-5.2.1.2 Protection and Separation in Systems Furniture and Utility Columns

Ensure that the cable is protected at all transition points, and that metallic separation is provided between telecommunication and power wiring in the utility columns and systems furniture track in accordance with TIA-569-C and NFPA 70.

### 2-5.2.2 Horizontal Distribution in Small Facilities and Renovations

In new construction involving small, mixed use (non-administrative) facilities, or construction projects involving renovation of existing buildings, use of J-hooks, flexible cable tray, and alternative support systems specifically certified for Category 6 cable is permissible, though not desirable. In renovation projects where access to the walls for installation of conduit and outlet boxes is not possible, or where historical requirements prohibit the alteration of the building structure, surface mounted non-metallic raceway may be used.

## 2-5.3 Pathway Components

### 2-5.3.1 Cable Tray

Utilize solid bottom, slotted bottom, or welded wire cable tray to provide a centralized cable management/distribution system.

- Use the cable tray for horizontal distribution to the maximum extent possible (80 percent to 90 percent of the horizontal cable length).
- Design cable trays to accommodate an initial calculated fill ratio of 25 percent (*Note: This allows for future growth within the cable tray. Due to random placement of cables and space between the cables, a 25 percent fill ratio means that in reality the tray is half filled.*)
- The maximum fill ratio of any cable tray is 50%.

- The maximum fill depth of any cable tray is 6 inches (150 mm).
- Do not use ladder cable trays for horizontal distribution due to possible cable deformation with large cable quantities.
- Provide and maintain a minimum of 12 inches (300 mm) access headroom above a cable tray system or cable runway.
- Coordinate with other disciplines to ensure that building components (e.g., air conditioning ducts) do not restrict access and that proper clearances can be achieved.

#### 2-5.3.2 Conduit

Design conduit systems in accordance with TIA-569-C. Install electrical-metallic tubing (EMT) conduit from the cable backbone distribution system, whether cable tray or enclosed duct, to each outlet unless a conduit-less system is approved by the telecommunications manager. Provide a minimum of 1 inch (27 mm) EMT conduit for standard outlets. When cable tray or enclosed duct is not used, install individual conduits from the TR to each outlet. Coordinate conduit bend radii with cable bend radius. Arrange conduit entries at outlet and junction boxes so that cables passing through the box enter and exit at opposite sides of the box. Do not use flexible metal conduit for telecommunications wiring except when installing floor-access boxes in a raised floor, where the floor-access box may be relocated within a specified service area. In this case the length of the flexible metal conduit must not exceed a length of 20 feet (6 m) for each run per TIA-569-C. Avoid using in-slab and below grade conduit systems for interior telecommunications designs as these systems provide the least flexible horizontal distribution system. If an in-slab or below grade conduit system is utilized in the telecommunications design, comply with NFPA 70 and utilize cables that are listed and rated for wet locations. Do not use plenum or riser rated cable, gel-filled OSP, and unlisted cables in such an environment. Consider that cables rated for a wet location typically have a larger outside diameter and this may affect conduit fill rates and conduit sizing. Larger conduit sizing in the slab may affect the structural integrity of the structure. For in-floor conduit systems, provide home runs back to the TR serving that area. Serve all telecommunications outlets from the TR located on that floor.

Use an optimal conduit fill ratio of 40 percent for conduit sizing. Do not exceed a fill ratio of 50 percent. Do not install more than four, four-pair cables in a 1 inch (27 mm) conduit. Do not use conduit in family housing projects unless it is a high-rise apartment building.

#### 2-5.3.3 Non-continuous Cable Supports

Non-continuous cable supports are not allowed in the following locations:

- In place of the cable tray system or as the sole distribution system in place of home-run conduit. Design non-continuous cable supports to support the category-rating of the cable. Supports must not exceed 20 cables or 50 percent of the fill capacity, whichever is less.
- That exceed 50 feet (15 meters) total length through a non-continuous cable support system.

- Ceilings in which Infection Control protocol affects ceiling tile removal
- In areas where the cable must be protected.

When utilizing non-continuous cable supports, provide in accordance with TIA-569-C.

#### 2-5.3.4 Pull and Splice Boxes

A pull box is defined as a housing located in a pathway run used to facilitate the placing of wire or cables. A splice box is defined as a box located in a pathway run intended to house a cable splice. Place pull and splice boxes in conduit runs in accordance with TIA-569-C.

## 2-6 **TELECOMMUNICATIONS CABLING**

Provide horizontal and backbone cabling in a hierarchical star configuration in accordance with TIA-568-C.1. The paragraphs in this section pertain to copper and fiber optic backbone and horizontal cabling. Cable to support Closed-Circuit Television (CCTV) and Community Antenna Television (CATV) is covered in the section titled *Other System Requirements*.

### 2-6.1 **Backbone Cabling**

The following subparagraphs pertain to copper and fiber optic intra-building backbone cable. Use no more than two hierarchical levels of cross-connects (main and intermediate) for the intra-building backbone. Use copper backbone cable only for voice circuits. Use fiber optic cable for data backbone circuits.

#### 2-6.1.1 Copper Backbone Cabling

Comply with the following:

- Provide multi-pair voice backbone cable that meets the requirements of Insulated Cable Engineers Association{ XE "ICEA:Insulated Cable Engineers Association" } (ICEA) S-80-576 and TIA-568-C for riser-rated unshielded twisted pair{ XE "UTP:unshielded twisted pair" } (UTP) cable.
- Use solid untinned copper, 24 American Wire Gauge{ XE "AWG:American Wire Gauge" } (AWG) conductors.
- Coordinate the copper backbone design with the telecommunications manager in order to minimize the amount of copper deployed.
- Utilize minimal copper backbone to support traditional two-wire phones and legacy systems as the transition to an all-fiber backbone occurs.
- For facilities that will utilize unified communications (i.e., voice, video, and data over Internet Protocol{ XE "IP:Internet Protocol" } (IP), provide a minimum 25-pair copper backbone to each TR. Provide additional cable counts to support actual legacy system requirements.
- For facilities utilizing legacy systems, provide copper backbone cables sized to support no more than 1.5 pairs for every outlet connected to the serving TR.

### 2-6.1.2 Copper Termination

Terminate outside plant (OSP) cable on a protected entrance terminal (PET). Terminate the copper backbone cable originating in the main telecommunications room{ XE "TR:telecommunications room" } (TR) or main cross-connect in each TR on 110-type, insulation-displacement wiring blocks mounted on the backboard. Provide 110-type terminal blocks on the same backboard as the PET and in each TR for copper backbone distribution. Utilize intermediate cross-connects when required by the telecommunications manager.

### 2-6.1.3 Fiber Optic Backbone Cable

Provide a minimum of 12 strands single mode fiber optic cable between the main telecommunications room, or main cross connect and each TR. Where required by NFPA 70 or by local regulations, fiber optic cable must be plenum rated.

Indicate the proper color coding of optical fiber cabling on design drawings. Use the TIA-598 jacket color coding scheme for fiber optic (FO) cable on military projects as follows:

Single-mode (ranges between 8 and10um) (OS1)	Yellow
Multimode 62.5/125um (OM1)	Slate
Multimode 50/125um (OM2)	Orange
Multimode 50/125um Laser Optimized (OM3)	Aqua

#### 2-6.1.3.1 Fiber Optic Termination

Terminate backbone FO cabling, at each end, on cabinet/rack-mounted patch panels with LC type connectors. \1\ Do not use ST or MT-RJ fiber optic adapters and connectors for new construction unless specifically required for interface with existing equipment reused on installations. Provide fiber optic adapters and connectors in accordance with the appropriate TIA-604 Fiber Optic Connector Intermateability Standard (FOCIS). Fusion-splice backbone fibers to factory produced pigtailed. /1/

## 2-6.2 Horizontal Cabling

The following subparagraphs pertain to copper and fiber optic horizontal cabling.

### 2-6.2.1 Copper UTP Horizontal Cabling

#### 2-6.2.1.1 Category 6 (CAT6) Cabling

Provide one CAT6 unshielded twisted pair (UTP) cable to each standard 8-pin modular jack. Use only cable that has passed the UL LAN certification program and is labeled with UL acceptable markings. Provide plenum rated cables in accordance with NFPA 70, or

when directed by the facility safety officer or UFC 3-600-01. Do not use Category 3, 5, or 5e rated cabling in new construction or rehabilitation projects.

*Note: When specifically required by other criteria, Activities may utilize screened or shielded twisted pair (ScTP or STP) cabling (such as in Europe or secure areas).*

#### 2-6.2.1.2 Category 6A (CAT6A) Cabling

Category 6A (CAT6A) and higher rated cabling is not adopted for general use in this UFC due to the increase in cable diameter, weight, cost, and additional testing requirements. The increased cable diameter and weight adversely affects the cable tray fill and loading for larger projects. Selection of CAT6A and higher cable must be based upon validated user requirements. Coordinate any use of CAT6A and higher rated cabling and associated cost changes with all stakeholders, technical reviewing authority, telecommunications manager, building occupants and other service specific authorities. Components used in a CAT6A system (i.e. outlets, patch panels, and patch cables) must also be CAT6A rated. When the requirements warrant the use of CAT6A and funding permits, activities may utilize shielded twisted pair (STP) cabling as this reduces the probability of alien crosstalk.

#### 2-6.2.1.3 CAT6 Termination

Perform terminations of the UTP cabling at the work area outlet and patch panel using an 8-pin, RJ45 type modular jack, rated for the category of the installed cable. Terminate horizontal cables in the telecommunications spaces on Category 6 rack-mounted patch panels. Facilities with minimal outlet requirements (normally less than 12) may use a small cabinet or backboard mounted CAT6 patch panel. Terminate cables from the same outlet on the same patch panel and individually identify the cables. Wire all terminations to the TIA 568-C.0, T568A configuration. Do not use the T568B wiring configurations unless specifically requested by the user and approved by the authority having jurisdiction. Do not split copper cables between multiple modular connectors.

*Note: Coordinate with telecommunications manager to determine if it is necessary to separately identify and differentiate "voice" and "data" systems.*

#### 2-6.2.1.4 CAT6 UTP Patch Cables

Provide 4-pair, minimum size 24 AWG stranded UTP copper patch cables rated for Category 6, with 8-pin modular plugs at each end. Due to performance and testing requirements utilize factory manufactured pre-connectorized patch cords. Provide patch cables of various lengths to terminate all required connections.

#### 2-6.2.2 Fiber Optic Horizontal Cabling

##### 2-6.2.2.1 Fiber Optic Cable

Provide fiber optic cable to each outlet only when required by the mission and approved by the telecommunications manager. Provide 50/125-um diameter laser optimized (OM3) multi-mode when the user requires fiber optic cable. When the telecommunications manager requires it, single-mode fiber optic cable (OS1), 50/125-um diameter (OM2) or



62.5/125-um diameter (OM1) multimode fiber may be substituted. Provide plenum cables in accordance with NFPA 70, or when directed by facility safety officer or UFC 3-600-01.

For in-slab or below grade telecommunications conduit systems, comply with NFPA 70 and provide cables listed and rated for wet locations. Do not use plenum or riser rated cable, gel-filled OSP, and unlisted cables in such an environment.

#### 2-6.2.2.2 Fiber Optic Termination

Terminate FO cable in cabinet/rack-mounted patch panels, and at the outlet using LC type connectors in accordance with the appropriate TIA-604 series document. Do not use ST or MT-RJ fiber optic adapters and connectors for new construction unless specifically required for interface with existing equipment reused on installations. Provide fiber optic adapters and connectors in accordance with the appropriate TIA-604 Fiber Optic Connector Intermateability Standard (FOCIS). Provide individual patch panels and distribution panels with 12 duplex LC, SC or MT-RJ adapters or 24 ST adapters maximum.

#### 2-6.2.2.3 Fiber Optic Patch Cables

Utilize fiber optic patch cable types and connectors of the same type as the patch panels to which they are interconnecting. Use duplex patch cables. Due to performance and testing requirements utilize factory manufactured pre-connectorized patch cords. Provide sufficient fiber optic patch cables, of various appropriate lengths, to terminate all fiber optic patch panel appearances plus 25 percent spare.

#### 2-6.2.3 Cable Length

In accordance with TIA 568-C.1, limit copper data cable length to 295 feet (90 m) from patch panel termination in the TR to the data outlet termination. If permitted by the agency specific chapters, system architectures such as collapsed backbones or passive optical networks (PON) may exceed the 295 foot (90 m) length.

### 2-7 **WORK AREA**

A work area is defined as the building space where the occupants interact with the telecommunications terminal equipment. In this UFC, consolidation points (CP) and a Multi-User Telecommunications Outlet Assemblies (MUTOA) are included within this area.

#### 2-7.1 **Work Area Outlets**

The following requirements apply to telecommunications outlets in the work area.

##### 2-7.1.1 Wall-mounted Outlet Box

Provide double gang electrical boxes, minimum standard size 4-11/16 inches (100mm) square and 2-1/8 inches (54 mm) deep with plaster ring for connection of single gang faceplate. Design outlet box for recess mounting with the faceplate flush with the wall surface, at the same height as the electrical outlets. Locate a quadruplex electrical outlet within 6 inches (152 mm) of all work area outlets to serve telecommunications loads associated with that outlet.

For the power outlet circuits, assume that each location of two duplex receptacles will power one personal computer with a monitor along with typical office appurtenances such as task lights, and assume that there will be no diversification of this load.

#### 2-7.1.2 In-floor Outlet Boxes

Use in-floor outlet boxes only if no other alternative exists for feeding systems furniture, classroom desks, lecterns in lecture halls, and other free standing furniture. In some instances an in-floor grid type system may be required to provide necessary flexibility.

### 2-7.2 Telecommunications Faceplates

#### 2-7.2.1 Work Area Outlet Faceplate

Provide single gang, four position, modular faceplate for each work area outlet. Standard configuration is two RJ-45 modular jacks and two blanks for future applications as shown in Figure 2-3. Provide other copper and fiber optic configurations to support special or legacy telecommunications systems when required.

**Figure 2-3 – Typical Faceplate Configuration**

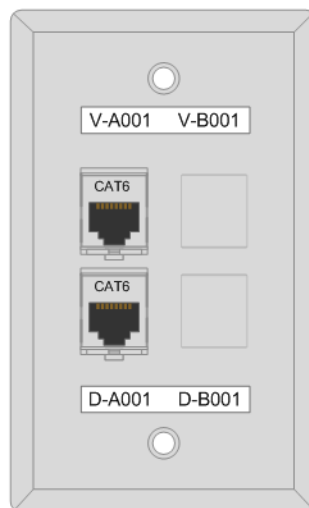


Figure 2-3 represents a single gang faceplate with two CAT6 modules, two blanks, and sample labeling. As the infrastructure converges to voice over internet protocol (VoIP), there will be no difference or distinction between voice or data modules.

#### 2-7.2.2 Wall-Mounted Telephone Faceplate

Provide single gang, single position modular faceplate with one wired modular jack and mounting lugs for each wall-mounted phone.

#### 2-7.2.3 Coaxial Faceplate

Provide single gang, single position modular faceplate with one F-type coaxial adapter.

### **2-7.3 Modular Jacks, Connectors and Adapters**

The following requirements pertain to copper, fiber optic and coaxial cable jacks, connectors, and adapters. For copper systems, utilize the same category rating for cable, jacks, and patch panels throughout the entire system.

#### **2-7.3.1 Copper Modular Jack**

Provide unkeyed Category 6 (CAT6) modular jacks in accordance with TIA-568-C.0, terminated per T568A configuration. Telecommunications manager approval is required for:

- Use of T568B configuration to maintain existing system uniformity
- Use of keyed modular jacks where required to maintain system uniformity, security, or other user specified reasons.

#### **2-7.3.2 Fiber Optic Connectors and Adapters**

Provide unkeyed duplex LC connectors and adapters in accordance with TIA-568-C.3. Terminate fiber optic cabling at both ends utilizing duplex LC connectors, and utilize adapters at faceplates and patch panels to align and connect fiber optic cables.

Telecommunications manager approval is required for:

- Use of other types of connectors and adapters such as SC, ST, and MT-RJ that are required to support existing systems.
- Use of small form factor connectors and adapters with high density patch panels. This may offer a potential cost reduction in facilities with a high outlet concentration.

#### **2-7.3.3 Coaxial Connectors and Adapters**

Provide F-type adapters and crimp on connectors in accordance with TIA-568-C.4.

Terminate coaxial cabling at both ends using threaded, crimp-on connectors for CATV or other systems. The use of any other connectors, such as BNC, requires telecommunications manager approval. Coordinate with the cable service provider where franchise agreements are in place.

### **2-7.4 Outlet Types and Density**

The number of work area outlets per square area (outlet density) required in a building varies greatly depending on the type of facility. Table 2-1 identifies facility space categories, work area outlet types, and densities commonly used in military construction projects. The outlet configuration options identified in Table 2-1 must be selected by the proponent and the telecommunications manager. The outlet types do not cover all possible user required configurations. Provide user-defined outlets that have a corresponding valid requirement, such as multiple levels of classification or dedicated systems. Provide outlet configurations that comply with this UFC and the current versions of TIA-568 and TIA-569. Outlet densities are provided for planning purposes when actual outlet locations are not known

and cannot be determined with available information. Actual designs must include outlets in work areas, office automation outlets, private office outlets, conference rooms, and wall or access phones as necessary.

Outlet densities are based on gross area (i.e. overall building footprint without deducting for areas such as hallways, equipment rooms, and restrooms). Outlet configurations, densities, and locations for all special-purpose spaces not identified in Table 2-1 must be determined by the user and the telecommunications manager. The above requirements can be modified if it is validated (documented in writing, signed and dated by the telecommunications manager) that mission operations require a quantity, configuration or design other than specified herein.

**Table 2-1 Outlet Types**

<u>Facility Space Category</u>	<u>Outlet Configuration</u>	<u>Planning Area (SF(SM)) per Outlet</u>
Administrative space, to include private offices, conference rooms, Classrooms, Medical/Clinics, Headquarters and Special Users	Two 8-pin modular (RJ45 type) outlet/connector OR One 8-pin modular and one Duplex fiber optic connector OR Two duplex fiber optic connectors in a single gang outlet faceplate.	80(7.5) with a minimum of two (2) dual outlets on different walls for private offices
Systems Furniture	Two 8-pin modular (RJ45 type) outlet/connector OR One 8-pin modular and one Duplex fiber optic connector OR Two duplex fiber optic connectors in a modular furniture outlet faceplate with outlet box extender.	See <i>Systems Furniture</i> paragraph below
Non-Admin Spaces (CDCs, Chapels, Rec-centers, etc.)	Two 8-pin modular (RJ45 type) outlet/connector OR One 8-pin modular and one Duplex fiber optic connector OR Two duplex fiber optic connectors in a single gang outlet faceplate.	500(46.5)
Barracks or Dormitory Space/Bachelors Quarters	Refer to <i>Barracks, Dormitory, Bachelor Quarters</i> paragraph below	See paragraph below
Warehouse space	Two 8-pin modular (RJ45 type) outlet/connector OR One 8-pin modular and one Duplex fiber optic connector OR Two duplex fiber optic connectors in a single gang outlet faceplate.	5000(465)

Wall and Pay Phone Outlet	One 8-pin modular (RJ45 type) connector in a single gang outlet faceplate with mounting lugs.	As needed
Family Housing units	Refer to <i>Family Housing Units</i> paragraph below	See paragraph below

#### 2-7.4.1 Systems Furniture

Provide a minimum of one systems furniture work area outlet per single occupancy cubicle and a minimum of two systems furniture outlets per cubicle designated for additional scanners, printers, copiers or fax machines.

#### 2-7.4.2 Barracks, Dormitory, Bachelor Quarters

Provide one CAT6 modular jack (RJ-45 type) in each bedroom and common area (living room) of the suite configured per TIA-570-C.

#### 2-7.4.3 Family Housing Units

Provide a complete structured telecommunications system throughout housing unit in accordance with TIA-570-C. Provide Grade 1 wiring outlets (one telephone outlet and one CATV outlet) as required by TIA-570-C and any other logical location deemed appropriate, including attached garages. UTP cabling and modular jacks must be a minimum CAT6.

#### 2-7.4.4 Utility Rooms

Provide at least one wall mounted telecommunications outlet in each utility room (e.g. electrical, mechanical and telecommunications spaces) to accommodate energy management systems.

#### 2-7.4.5 Elevators

Provide a standard work area outlet to the elevator machine room for each elevator.

#### 2-7.4.6 Safety, Courtesy, & Convenience

Provide wall-mounted telephone outlets at all logical locations to support safety, courtesy, and convenience. Examples include the following:

- a. Safety: barracks hall, laundry room.
- b. Courtesy: building lobby/entrance.
- c. Convenience: break rooms, rear (unmanned) entrances.

#### 2-7.4.7 Multi-user Telecommunications Outlet Assembly (MUTOA)

A Multi-user Telecommunications Outlet Assembly (MUTOA) is defined as a grouping in one location of several telecommunications outlet/connectors. TIA-568-C.1 allows MUTOAs in an open office environment. This option provides greater flexibility in an office that is

frequently reconfigured. A MUTOA facilitates the termination of single or multiple horizontal cables in a common location within a furniture cluster or similar open area. The cables from MUTOAs to work stations in system furniture or open office are supported by the systems furniture raceway and the length must be calculated in accordance with TIA-568-C.1 when establishing the total channel length. MUTOAs do not include an additional connection, and are limited to terminating a maximum of 12 users. Locate MUTOAs and route cables within systems furniture in accordance with TIA-568-C.1.

#### 2-7.4.8 Consolidation Point (CP)

A Consolidation Point (CP) is defined as an interconnection point within the horizontal cabling using TIA-568-C.2 or TIA-568-C.3 compliant connecting hardware. It differs from the MUTOA in that it requires an additional connection for each horizontal cable run. A CP may be useful when reconfiguration is frequent, but not so frequent as to require the flexibility of the MUTOA. CP's are limited to terminating a maximum of 12 users. Locate CPs in accordance with TIA-568-C.1.

### 2-8 OTHER SYSTEM REQUIREMENTS

#### 2-8.1 Closed-Circuit Television (CCTV) System

When closed-circuit television requirements are identified, provide either a 75-ohm broadband quad-shield coaxial cable, single-mode fiber optic cable, or a category rated cable system. Refer to the paragraphs above for fiber optic and category rated cable. Ensure the correct cable is used in CCTV systems. Provide plenum cables in accordance with NFPA 70, UFC 3-600-01, or when directed by the facility technical reviewing authority. CCTV cable distances are affected by multiple variables such as signal strength at the source, signal loss of cable, and CCTV components.

For CCTV security systems coordinate with \1\ UFC 4-021-02. /1/

#### 2-8.2 Community Antenna Television (CATV) System

Community Antenna Television Systems are generally referred to as Cable TV. Provide a complete system to be owned and maintained by the government consisting of backboards/cabinets, cable, conduit, and outlets with jacks in all offices and other user required locations. Coordinate with the local CATV service provider. Include amplifiers, splitters, combiners, line taps, cables, outlets, tilt compensators and all other parts, components, and equipment necessary to provide a complete and usable system. Include the headend amplifier as part of the system when required by the local provider. Passive CATV devices must support 1 gigahertz bandwidth.

##### 2-8.2.1 System Requirements

Provide a TIA-568-C.4 and NFPA 70 compliant system. Use a star topology distribution system with each CATV outlet connected to a TR with a feeder cable or a drop cable and each TR connected to the head end equipment with a trunk cable. Provide a high quality signal to all outlets with a return path for interactive television and cable modem access. System must operate within the 5 to 1000 Megahertz bandwidth using 1000 MHz passive

devices and a minimum of 750 MHz active devices. Provide a minimum signal level of 0 decibel millivolts (dBmV) (1000 microvolts) and a maximum of 15 dBmV at 55 and 750 MHz at each outlet.

### 2-8.2.2 Cabling

\1\ Utilize either a 75-ohm broadband quad-shield coaxial cable or single-mode fiber optic cable system. For fiber optic cables, follow horizontal and backbone cabling requirements. For coaxial systems less than 295 feet (90 m) from headend equipment to the TR, or from TR to TR, provide RG-11 coaxial trunk cable. For systems exceeding 295 feet (90 m) from the headend equipment to the TR or from TR to TR, consider utilizing 625 series cable to reduce system losses. Utilize RG-6 coaxial cables for drops from the TR (or headend) to the wall outlet. Do not use RG-59 for CATV projects. /1/

### 2-8.3 Wireless Access Points (WAP)

When a wireless local area network (WLAN) system or a wireless intrusion detection system (WIDS) is required, design in accordance with TIA Telecommunications Systems Bulletin 162-A (TSB-162-A) Telecommunications Cabling Guidelines for Wireless Access Points. TSB-162-A recommends the use of category 6A (or higher) twisted-pair and OM3 (or higher) optical fiber cabling to support higher data rates and, in the case of twisted-pair cabling, lower temperature rise when remote power is applied. However the determination of whether a Category 6A (or higher) twisted-pair or OM3 (or higher) optical fiber cabling is used must be based on the following:

- Complexity of maintaining multiple cabling systems (Category 6 for work area outlets and Category 6A or optical fiber for support of WAPs)
- Funding constraints to procure and maintain multiple cabling systems and test equipment.
- Space to accommodate hardware associated with multiple cabling systems. For example, a Category 6A cabling system installed to support a wireless system must be terminated on Category 6A patch panels.

Provide two twisted-pair cables, Category 6 or 6A terminated on standard 8-pin modular connectors or two fiber multimode optical fiber strands, OM3 or higher for each wireless access point. Install the WAP cabling infrastructure in the same manner as other telecommunications outlets required in this UFC. Include the cable tray and conduit or J-hooks to support the cable connected to the WAP. The use of "J" hooks, flexible cable tray(s), and alternative support systems specifically certified for the cable utilized is permissible to support the WAPs from the cable tray. Do not exceed a 50 percent fill ratio for the "J" hooks. Support horizontal cabling to distribution areas in cable tray(s).

*Note: When funding permits, activities may utilize shielded twisted pair (STP) cabling for WAPs. Shielded cables reduce the probability of alien crosstalk and also help to dissipate heat when the cable is used to provide power.*

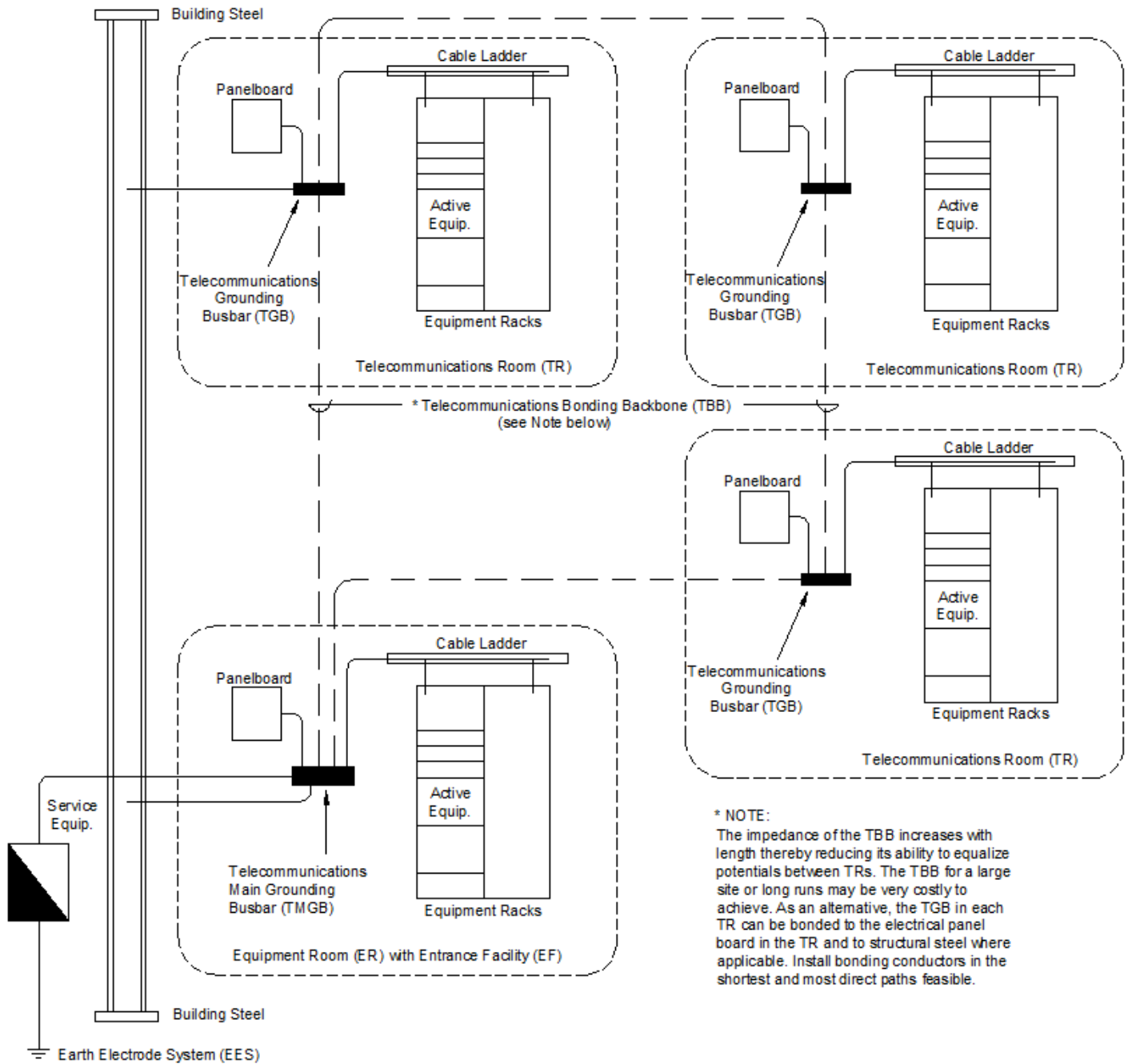
2-9            **GROUNDING, BONDING, AND STATIC PROTECTION**

Comply with NFPA 70 for grounding and bonding requirements. Provide a telecommunications bonding and grounding system in accordance with TIA-607-B. Refer to Figure 2-4 below. Building grounding systems are covered in UFC 3-520-01 Interior Electrical Systems.

*Note: The TIA-607-B identifies a bonding conductor known as the telecommunications bonding backbone (TBB) which is intended to equalize potentials between TRs. It should be recognized that the impedance of the TBB increases with length, thereby reducing its ability to equalize potentials between TRs. The ITS designer must consider that the TBB for a large site may be very costly to achieve. As an alternative, the TGB in each TR can be bonded to the electrical panel board in the TR and to structural steel where applicable. Install bonding conductors in the shortest and most direct paths feasible.*



Figure 2-4 – Telecommunications Grounding and Bonding Infrastructure



2-9.1 Cable Entrance Grounding

Connect all metallic shields and strength members for outside plant cable entering a building to the electrical service grounding electrode system in accordance with NFPA 70, Article 800. Bond the OSP cable shield, armor, and metallic strength member to the main building ground as close as possible to the building point of entrance with a No. 6 AWG or larger ground wire. Use a non-bonded splice case for the transition from OSP rated cable to interior rated cable. If the designer extends the OSP cable past 50 feet (15 m), \1\ bond

the metallic strength member /1/ to the TMGB with a No. 6 AWG or larger copper ground wire, as close to the conduit egress point as possible.

#### 2-9.1.1 Protected Entrance Terminals

Terminate all incoming OSP copper cables on UL-listed primary protector blocks, located within the building entrance terminal cabinet. Provide protector blocks equipped with 5-pin solid state, gas, or hybrid protector modules for the number of pairs terminated. Bond the protector blocks to the main electrical service ground via the TMGB or TGB with a No. 6 AWG or larger copper ground wire.

#### 2-9.2 Telecommunications Spaces Bonding and Grounding

Bond all telecommunications spaces and infrastructure in accordance with TIA 607-B where applicable.

#### 2-9.3 Telecommunications Rack and Supporting Structure

Bond all telecommunications racks and supporting metallic structures (cable trays, ladders, conduits and baskets) in accordance with TIA-607-B. Non-continuous distribution systems (i.e. stub-ups, J-hooks) do not require bonding.

### 2-10 TELECOMMUNICATIONS SYSTEM ADMINISTRATION

Provide administration for the complete telecommunications system in accordance with TIA-606-B. Determine the minimum class of administration by evaluating the size and complexity of the premise infrastructure. Ensure the format for identifiers is backwards-compatible with TIA-606-A for installations in existing facilities or per ISO/IEC TR4763-1 for new facilities unless otherwise directed by telecommunications manager. Coordinate with telecommunications manager and appendices at the end of this document for any additional service-specific labeling or administration requirements. Color-coding of telecommunications infrastructure and components is recommended, but not required.

### 2-11 TELECOMMUNICATIONS SYSTEM TESTING

All installed backbone and horizontal telecommunications cabling and connecting hardware must meet minimum performance requirements and be tested in accordance with TIA-568-C. Provide report of all tests results and certifications to the proponent and telecommunications manager upon completion.

#### 2-11.1 Unshielded Twisted Pair (CAT6) Cabling and Connecting Hardware

Perform all required testing to insure minimum performance requirements are met in accordance with ANSI/TIA/EIA-568-C.2.

#### 2-11.2 Fiber Optic Cabling and Connecting Hardware

Perform all required testing to insure minimum performance requirements are met in accordance with TIA-568-C.1 for cabling and TIA-568-C.3 for connecting hardware.

### 2-11.3 **Coaxial Cabling and Connecting Hardware**

Perform all required testing to insure minimum performance requirements are met in accordance with TIA-568-C.4.

### 2-11.4 **Test Plan**

The contractor must submit for Government review a draft test plan of all proposed cabling and equipment being installed under the project. Upon the draft's approval, the contractor must prepare a finalized test plan to the Government. After the contractor has completed the installation and testing of the ITS, the contractor must submit a test report for all fiber and copper cabling. The contractor's RCDD must approve both the test plan and the test report before submitting to the government.

*Note: Test plans for small scale projects as delineated in paragraph 2-1.2 do not require RCDD approval.*

The test plan must include, along with all testing system reports, a complete project test summary spreadsheet with indexed room numbers, outlet labels, jack labels and the pass/fail status, and causes for failures along with a total number of outlets installed, jacks/cable runs installed and the total number of jacks/cable runs that passed and failed the tests. All failed tests, require the contractor to correct the failures prior to turnover of the system. Tier 2 testing, data, analysis is required by the government at the contractors expense if Tier 1 testing does not prove adequate for identifying causes of failures, and if the government is responsible for paying for any repairs not within the original scope of contract.

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### **CHAPTER 3 AIR FORCE SPECIFIC REQUIREMENTS (RESERVED)**

This chapter reserved for future use. Current Air Force requirements are reflected in chapters 1 and 2.

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## CHAPTER 4 ARMY SPECIFIC REQUIREMENTS

### 4-1 INTRODUCTION

#### 4-1.1 Purpose

This chapter provides additional requirements and guidance for Department of Army projects.

#### 4-1.2 Army Technical Authority

### 4-2 SPECIFIC REQUIREMENTS

#### 4-2.1 Government-Designed Projects

Government-designed (in-house) projects require the approval of the service appointed telecommunications agent, prior to bid, IAW regulations, policies, memorandums, and guidance.

#### 4-2.2 Classified Infrastructure

Use the following documents for projects that include Secret Internet Protocol Router Network (SIPRNET) requirements:

- SIPRNET Technical Implementation Criteria, U.S. Army Information Systems Engineering Command (AKO Login Required)  
[\1\ https://www.us.army.mil/suite/files/5744948 /1/](https://www.us.army.mil/suite/files/5744948)
- UFGS 27 05 29.00 10 Protective Distribution System (PDS) for SIPRNET Communication Systems  
[www.wbdg.org](http://www.wbdg.org)

#### 4-2.3 Telecommunications Spaces

##### 4-2.3.1 Collocation of other telecommunication systems

It is permissible to collocate CATV, CCTV, fire alarm and electronic security systems (ESS) inside the TR. Final decision authority is the US Army Network Enterprise Technology Command (Army NETCOM).

##### 4-2.3.2 Multi-Story Buildings

Approved Standard Designs may deviate from stacked TRs when no other solution is feasible.

##### 4-2.3.3 Barracks, Dormitory, and Bachelor Quarter TR Sizing Considerations

Standard TIA-569-C TRs are normally too large for these types of facilities. Provide an 8-foot by 10-foot main TR on the first floor, and provide a minimum of one 6-foot by 8-foot TR on subsequent floors. Provision the TRs in these facilities in accordance with

TIA-569-C. Telecommunication enclosures are acceptable in barracks with non-linear designs. Treat floors, walls, and ceilings to eliminate dust as defined in TIA-569-C.

#### 4-2.4 **Telecommunications Pathways**

##### 4-2.4.1 Direct Connection of Systems Furniture

Figure 1, of Appendix B (future), shows two possible solutions for direct wiring to the systems furniture. This concept is one of a continuous home run from the telecommunications space to the furniture outlet. Continuous runs are not recommended, and should only be used in open office environments that cannot be readily reconfigured. Testing of the installed cable plant is simplified by providing an end-to-end circuit, without an additional connection point.

Follow the guidance of TIA-569-B, section 6.3.2 for direct connection application and design.

##### 4-2.4.2 Conduit-less Systems

Where allowed by the Activity, local codes and the telecommunications manager, a conduit-less system may be utilized from the centralized cable tray to the work area outlet. In this type of horizontal distribution no conduit is installed from the cable tray to the work area outlet. Use non-continuous supports (J-hooks) to support the cable from the centralized cable tray to the top of the wall containing the work area outlet, then install the cable in the wall cavity to a low voltage mounting bracket.

#### 4-2.5 **Fiber Optic Backbone Cable**

The *DISN Enterprise Network Installation and Campus Area Network (ICAN) Design and Implementation Standards and Specifications* dictates the use of single mode fiber cables for building backbones on Army projects.

#### 4-2.6 **Work Area**

##### 4-2.6.1 Work Area Outlets

##### 4-2.6.1.1 Wall-mounted Low Voltage Brackets

When utilizing a conduit-less system provide double gang low voltage brackets or backless outlet boxes at the work area location. The backless low voltage outlet box accommodates bend radius requirements of low voltage cabling.

##### 4-2.6.2 Outlet Types and Density

##### 4-2.6.2.1 Barracks, Dormitories, Bachelor Quarters

For Army Barracks, provide two CAT6 modular jacks (RJ-45 type) in a single gang outlet faceplate. Provide CATV outlets with "F" type jacks. Located CATV outlets in the kitchen, living room, family room, and all bedrooms adjacent to a duplex electrical receptacle.



#### 4-2.6.3 General Range Information Infrastructure Design

Follow the general provisions of this UFC for telecommunications sections of new range construction and renovation projects. Several distinct types of information networks are present in a range environment: administrative, range control, and tactical. The administrative networks support telephone and data requirements to the occupants of the range buildings, and safety telephones. The special Range Control networks control downrange targets, sensors, and monitors and transport this information to off-site locations. The tactical networks support the unit training requirements in a field environment. Security and alarm networks may also be present.

#### 4-2.6.4 Inter-Building and Outside Plant Requirements

\1\ Comply with Chapter 3 of the I3ATechnical Criteria until UFC 3-580-02 is published.  
/1/

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## CHAPTER 5 NAVY SPECIFIC REQUIREMENTS

### 5-1 INTRODUCTION

#### 5-1.1 Purpose

This chapter will be used by the Navy to provide additional guidance and planning information for Department of Navy (DoN) projects that will require Navy Marine Corps Intranet (NMCI) network connections. Navy Medical Facilities must comply with the Defense Medical Facilities Office (DMFO) criteria, including UFC 4-510-01, Design: Medical Military Facilities and are not normally part of NMCI.

*Note: For the purpose of this document, the term “NMCI” will be used to reference the network provided for use by the Navy and Marine Corps; Next Generation Enterprise Network (NGEN) will be used to reference the contract between the government and the contractor providing the NMCI network service.*

All NAVFAC Facilities Engineering Commands (FEC), Public Works Departments (PWD), Resident Officer in Charge of Construction (ROICC) offices, Base Communications Officer (BCO), and other concerned parties in the process, must refer to this document when designing, planning or preparing documentation for new projects that will require operational NMCI support.

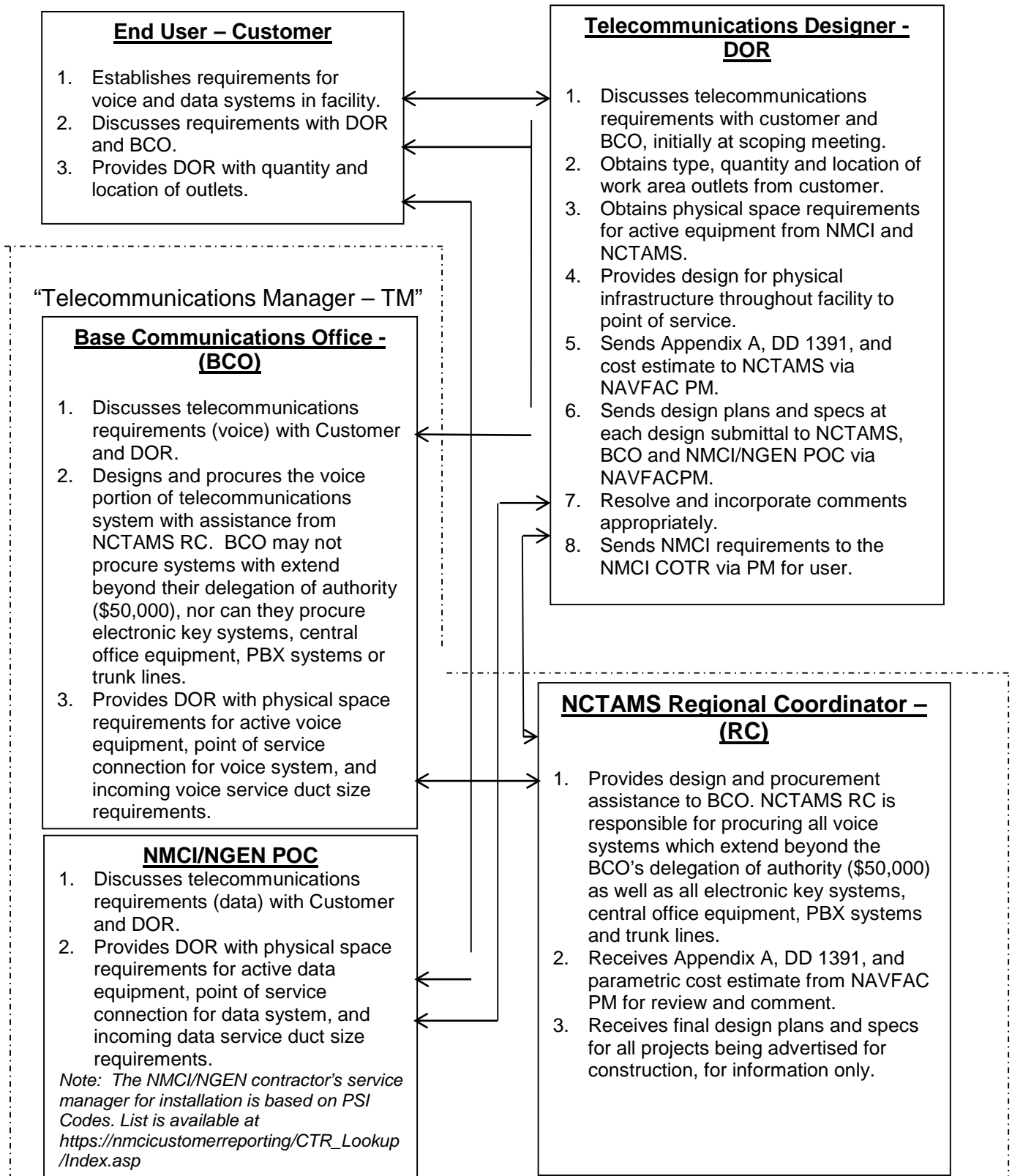
#### 5-1.2 Order of Precedence

This document does not and cannot supersede or add to the requirements of the NMCI Next Generation (NGEN) contract. If conflicts arise between this document and the NGEN contract, the NGEN contract governs.

#### 5-1.3 Coordination

Although this criteria document was written to be as inclusive as possible, Information Technology (IT) installations may vary greatly from building to building. It is therefore imperative that the government facilities team (Naval Enterprise Networks (NEN) Program Office, Commander Navy Installations Command (CNIC), and Naval Facilities Engineering Command (NAVFAC) components), facility design team, and construction contractor coordinate closely at each stage of planning, design and construction. The telecommunications system Designer of Record (DOR) must coordinate his efforts for each design with the applicable entities identified in Figure 5-1.

**Figure 5-1 – Navy Telecommunications Coordination Chart for Typical Design/Bid/Build for Non-National Capital Region (NCR) Projects**



## 5-2 **SPECIFIC REQUIREMENTS FOR NMCI CONSTRUCTION**

### 5-2.1 **Collocating Various Systems**

Provide adequate space in TRs to facilitate tenant-owned telecommunications systems, and other low-voltage systems such as fire alarm, CATV, CCTV, and ESS.

### 5-2.2 **Bachelor Quarters Considerations**

Standard TIA-569-C TRs are normally too large for these types of facilities. For multi-story quarters, provide a minimum of one 8 ft (2.4 m) by 10 ft (3 m) main TR on the first floor and a minimum of one 6 ft (1.8 m) by 8 ft (2.4 m) TR on subsequent floors. Provide additional TRs on the main and subsequent floors as required to meet system limitations.

### 5-2.3 **Fiber Optic Backbone Cabling**

Provide single mode fiber optic cabling (OS1) for building backbones on all projects to future proof the network and standardize the backbone. Additionally, this permits the option of flattening the network via direct connection to switches in TRs other than the main TR. In existing Navy facilities with multimode cables and switches, coordinate with the activity and the NMCI/NGEN contractor to determine whether the switch optics will be changed to utilize the single mode backbone, or if multimode cable must also be provided in addition to the single mode. If using multimode, OM3 (which permits data rates up to 10 Gig) is first choice. OM2 and OM1 should only be used to supplement existing systems.

### 5-2.4 **Navy-Specific Technical Authorities**

For the purposes of implementing fiber to the desktop, Designer of Record must have justification in writing from the End User certifying that the 1391 supports this requirement, and from the NMCI/NGEN point of contact certifying that this requirement is included in their planned system.

### 5-2.5 **Barracks, Dormitory, Bachelor Quarters**

Provide a minimum of one standard telecommunications outlet in each bedroom and common area (living room) of the suite. Comply with FC 4-721-10N, Navy and Marine Corps Unaccompanied Housing.

### 5-2.6 **Utility Rooms**

Coordinate with other disciplines and the Activity to determine if a voice or data outlet is needed in mechanical or electrical utility spaces, (for smart metering or automated building control systems).

## 5-3 **OUTSIDE CABLE PLANT**

Outside Plant (OSP) requirements were in the UFC 3-580-10 which has now been cancelled. The requirements are included here, until the UFC 3-580-02 is completed.

### 5-3.1 Pathways

Coordinate with the NMCI Contractor to determine if the NMCI pathways can be routed in the same duct bank with other telecommunication conduits. If so, conduits beyond the 5 feet (1.5 m) line and manholes are MILCON funded to the closest manhole where service exists. The location of underground structures and the necessary interconnecting ducts must be explicitly described and identified in the contract documents.

For new buildings, provide a minimum of one 4 inch (103 mm) conduit for NMCI service. Provide a minimum of two conduits for multi-story buildings. Utilize three innerducts (two 1.5 inch (41 mm) and one 1 inch (27 mm)) or three fabric mesh innerducts in each conduit. Install a pull wire inside each of the innerducts. This is in addition to the conduits required for other telecommunications services; i.e. telephone, cable television, fire alarm and intrusion detection.

### 5-3.2 Detection

Provide electronic detection for each pathway in accordance with the following:

- Utilize detectable warning tape or tracer wire above the duct back for new installations.
- Utilize tracer wire when pulling new cable in existing duct systems.

### 5-3.3 Cabling

Standard NMCI practice utilizes Single Mode (SM) fiber optic cable, with a minimum core size of 8 microns as the transport medium between building EFs.

- Install fiber underground in conduit.
- A minimum of 12 strands of SM fiber is required; coordinate with the NMCI contractor for additional requirements. Provide fiber with facility contract.
- If classified seats are supported and unencrypted classified communication occurs over the outside plant cabling, conduits are required and must normally be encased in concrete. Comply with applicable Protected Distribution Systems (PDS) requirements, including IA PUB-5239-22, *Protected Distribution System (PDS)*.

## CHAPTER 6 USMC SPECIFIC REQUIREMENTS

### 6-1 INTRODUCTION

#### 6-1.1 Purpose

This chapter will be used by the United States Marine Corps (USMC) to provide additional guidance and planning information for USMC projects that will require telecommunications or information technology (IT) network connections.

- All USMC projects must use an optical solution as the first course of action when planning and designing new projects. Exceptions to this can only be granted by the USMC installations advocate or where life safety is concerned due to local building codes. Refer to Chapter 2 of this UFC for non-optical solutions.
- All NAVFAC Facilities Engineering Commands (FEC), Public Works Departments (PWD), Resident Officer in Charge of Construction (ROICC) offices, Installations' G/S-6, and other concerned parties in the process must refer to this document when designing, planning or preparing documentation for new projects.

#### 6-1.2 USMC Technical Authority

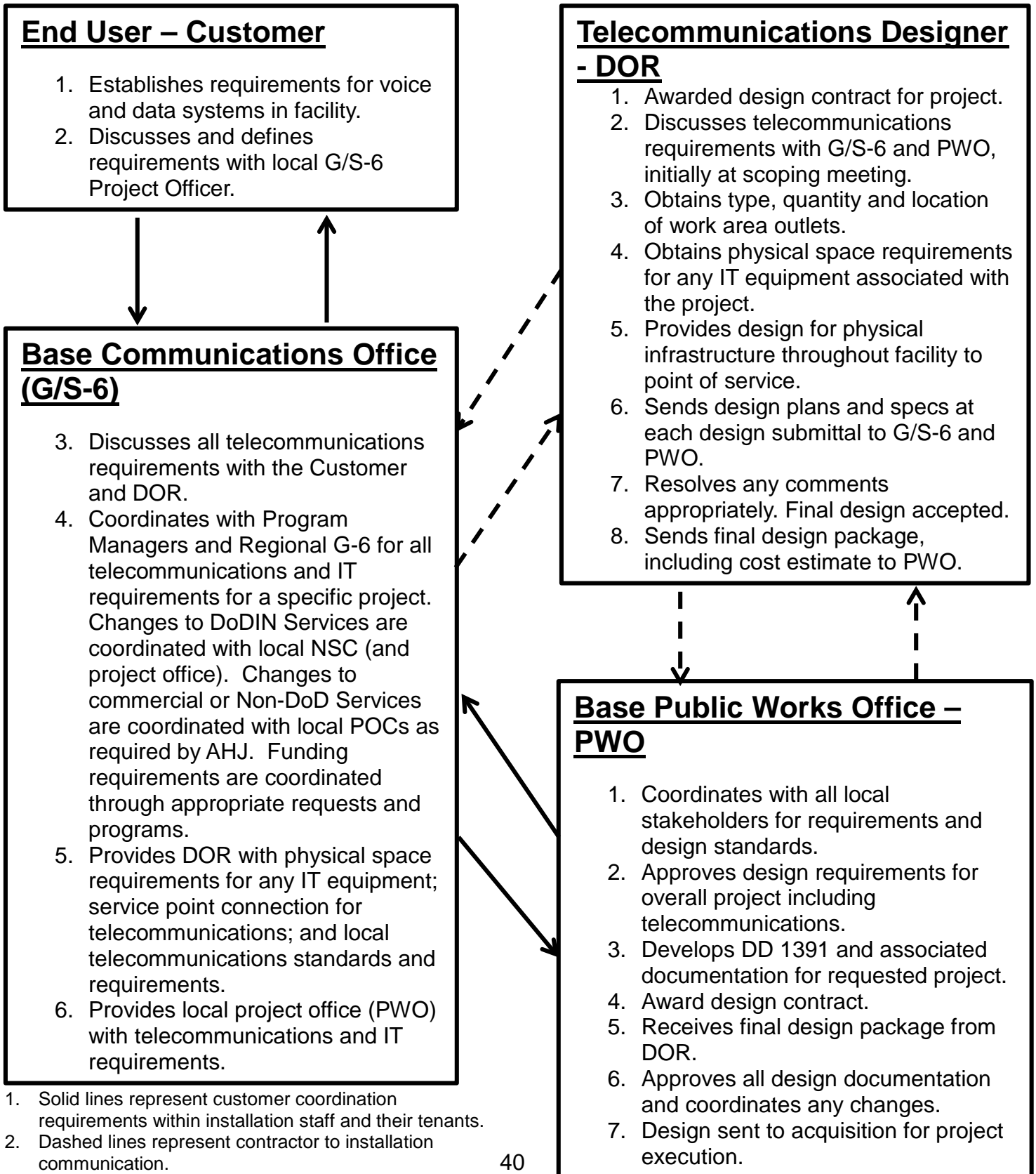
All telecommunications infrastructure must meet the needs of the activity and supporting facilities in accordance with this document. A/E contractor-generated final drawings and specifications for design-bid-build and design-build projects must be stamped by a BICSI Registered Communications Distribution Designer (RCDD). Design and construction may be concurrent efforts in Design-Build projects, and multiple phases may be approved. Therefore, each phase and/or project must be stamped.

Modernization of telecommunications systems within existing facilities solely for the purpose of meeting design criteria in this UFC is not required.

#### 6-1.3 Coordination

Although this criteria document was written to be as inclusive as possible, Information Technology (IT) installations may vary greatly from building to building. It is therefore imperative that the government facilities team as stated above, facility designer, and construction contractor coordinate closely at each stage of planning, design and construction. The Designer of Record (DOR) must coordinate his efforts for each design with the applicable entities identified in Figure 6-1.

**Figure 6-1 – USMC Telecommunications Coordination Chart for Typical Design-Build and Design-Bid-Build Projects**





## 6-2 **SPECIFIC REQUIREMENTS FOR USMC PROJECTS**

### 6-2.1 **Government-Designed Projects**

Government-designed (in-house) projects require the approval of the service appointed telecommunications agent, prior to bid, IAW regulations, policies, memorandums, and guidance.

### 6-2.2 **Classified Infrastructure**

Classified work areas, rooms and facilities must comply with MCO 5530.14A - Marine Corps Physical Security Program Manual.

### 6-2.3 **Collocation Of Other Telecommunication Systems**

It is permissible to collocate CATV, CCTV, control systems, fire alarm and electronic security systems (ESS) inside the TR. Tenant owned systems, that are not considered part of the facility are not accorded space within a TR. Planning for an equipment room will be considered as required if there are no other hosting capabilities available. Final decision authority is the local Installation Commander or AHJ.

### 6-2.4 **Telecommunications Rooms (TR)**

Follow the general requirements of Chapter 2 with the following additional requirements. Minimum dimensions – 10 feet 8 inches (3.25 meter) by 12 feet (3.6 meter), meeting all TIA-569-C standards with the below exceptions.

- Base sizing of room on the additional systems requirements of the service space such as BMS, ACMS, IDS, fire-alarm panels, and A/V equipment.
- Provide a minimum of two standard 19 inch cabinets per TR. Equipment racks will be used by exception due to physical security requirements and other specific facility requirements.
- In facilities or structures that only require the minimum infrastructure to the EF, one cabinet may be used and the room resized appropriately.
- Mount all cabinets to the permanent floor, centered in the TR to meet ADA access requirements.

Treat floors, walls and ceilings to eliminate dust by providing eggshell or semi-gloss paint finish, light in color to enhance room lighting. Provide one wall outlet installed at or near the entry door for emergency or primary voice communications.

### 6-2.5 **Cabinet Layout**

The typical TR cabinet layout will include PETs, Patch Panels, ONTs and Optical Splitters. Other cabinet components are defined in Chapter 2 of this UFC. Locate OLTs at the Area Distribution Node and define in UFC 3-580-02 when published.

#### 6-2.4 **ONT Placement**

Do not place rack-mounted ONTs with more than 120 Gbe interfaces per PON port off of the OLT. Current ONTs configured with 24-ports are grouped in multiples of five onto a 1:8 or 2:8 (for pathway redundancy) passive optical splitter.

#### 6-2.5 **Optical Splitters**

Locate splitter at a central aggregation point or EF when feeding a single ONT at a remote location, EUB, or hybrid A/V rack area. This is the demarcation point of an EUB. Place the optical splitter at the ADN if the facility will house four to five ONTs, and will require only a single (or two for redundancy) strand(s) of OSP fiber to the OLT. However, if this EUB requires dual homing or special redundancy, locate a secondary 2:1 splitter to connect the ONT and allow for two OLTs to be interfaced into the EUB 2:1 splitter.

It is important to ensure that the optical loss budget is taken into account. As the common POL budget is from -8 to -28dB, there may be a requirement to attenuate the optical signal via a splitter or attenuator to allow for proper ONT operation.

#### 6-2.6 **Patch Panels and Patch Cords**

Provide patch panels to support locking or keyed patch cords for improved physical security and the ability to meet fixed emergency communication location requirements. Code or key patch cords in accordance with the type of service they are providing; i.e. primary voice, data, video, or SCADA.

Provide bend-insensitive, pre-terminated patch cords capable of being locked into place to avoid accidental disruption of services or tampering. For OLT to Fiber Optic Patch Panel (FOPP) connections, provide SC-UPC to SC-APC patch cords. Provide all other patch cables to match the patch panel they are connecting. LC-APC connectors and patch panel adapter bulkheads are acceptable for increased density; however they are not permissible at the information outlet faceplate.

#### 6-2.7 **Telecommunications Pathways Interior Conduit**

Provide all wall-mounted work area outlets with rigid metal conduit stubbed up from the outlet to the horizontal cable distribution system. Utilize cable trays or non-continuous supports (J-hooks) to support the cable from the TR to the top of the wall containing the work area outlet, then route the cable in the wall cavity to a low-voltage mounting bracket.

#### 6-2.8 **Work Area Outlets**

Connect work area outlet faceplates to a double-gang, 4 inch x 4 inch (100 mm x 100 mm) outlet box, at least 3.5 inch (89 mm) deep to accommodate fiber inserts, slack management, and potential in-wall signal converters.

### 6-2.8.1 Type 1 Outlet

Terminate Type I Horizontal fibers in a traditional faceplate. Because ONTs typically allow multiple Ethernet interfaces, a single fiber interface per workstation/classification is typically all that is required. This consists of a traditional wall plate equipped with two single-port SC-APC connectors. This scenario provides flexibility in that any ONT type can be utilized in the design, along with other traditional duplex send and receive fiber pair technologies that may be required under special circumstances.

When utilizing fiber outlets for desktop or surface mounted ONTs, the outlet connectors for the horizontal fiber drop must be an individual snap-in style and fit securely into the faceplate housing. The connector must be compatible with single-mode SC-APC fiber. SC-APC is recommended throughout the installation to ensure compatibility with RF video service and future 10GPON applications utilizing the 1577 nm wavelengths. Angled connectors or inserts with hinged dust covers are recommended to minimize fiber end face contamination.

#### 6-2.8.1.1 ONT COPPER ETHERNET INTERFACES

For ONTs equipped with Ethernet interfaces, provide a minimum of one (1) 10/100/1000 RJ-45 interface conforming to IEEE 802.3 standards. A quantity of two or four 1000 Base-T interfaces are recommended to comply with current industry best-practices. 10/100 Base-T interfaces and those not supporting PoE or PoE+ are not permissible except in scenarios where RF video or POTS services are being provided.

#### 6-2.8.1.2 ONT COPPER ANALOG INTERFACES

ONTs equipped with analog POTS provide various quantities (2, 4, or 24 depending on the model) of RJ-11 or RJ-21 telephone jacks for connection of analog devices (telephones, Faxes, modems, etc.). These interfaces may provide 600 or 900 Ohm terminations and adhere to typical analog voice wire length specifications.

#### 6-2.8.1.3 ONT COAXIAL OUTLET/CONNECTOR

ONTs equipped with RF video interfaces can provide broadcast television service or any RF frequency up to 1 GHz. The coaxial outlet/connector integrated within the ONT is a standard, male 75-Ohm "F" type connector. The designer must coordinate with the cable service provider where franchise agreements are in place and additional head-end components such as an RF combiner, laser modulator and fiber amplifier (EDFA) will be required for POL distribution of RF services.

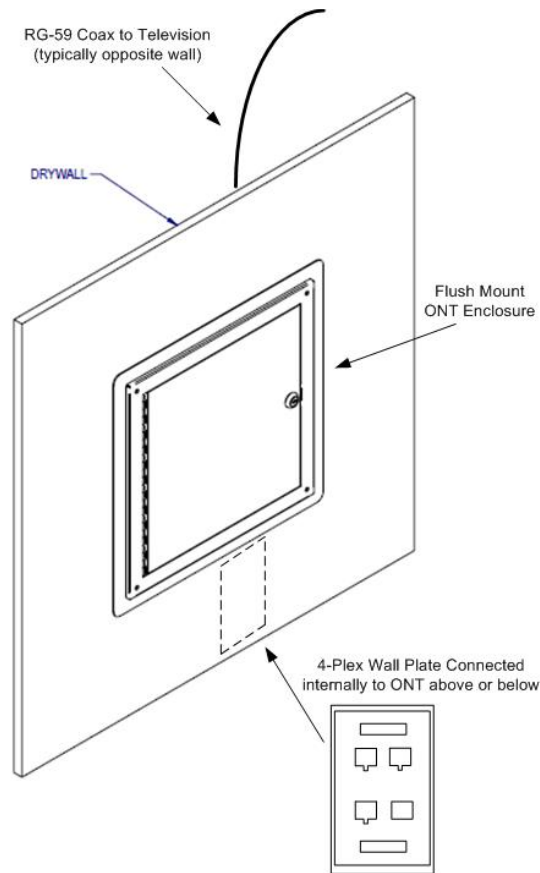
#### 6-2.8.1.4 ONT DENSITY (PORT SHARING)

Consider the end user requirements with regard to the number of information outlets at a workstation when designing a POL system layout. While some IP endpoints (including printer locations, IP Surveillance, Access Control Entry Points, and building automation systems) may require multiple ports for connectivity to various Ethernet devices or multiple networks, there are many instances where a workstation or IP endpoint need only connect to perhaps one or two network interfaces. In this scenario, it is acceptable to allow for port sharing between ONTs to increase the operational and

financial savings associated with the POL deployment. In the port sharing deployment, adjacent cubicles or modular workstations can share the ports of a single ONT by distributing copper Ethernet patch cables between the cubicles. The quantity depends upon the number of required interfaces for each workstation and/or the forecasted growth of the end user's network requirements. In many cases, an IP telephone can be installed in tandem with a user's PC or workstation eliminating the need for a duplex Ethernet jack per user. This allows for as many as four users to share a single, four-port ONT for example. Another scenario is one which provides two jacks per workstation so that the ONT's are shared at a 2:1 ratio. Regardless of port sharing, the designer must provide a single WAO at each workstation for future growth and flexibility.

#### 6-2.8.2 Type 2 Outlet

The Type 2 Outlet mirrors the approach of a Type 1 deployment with the exception of the termination of the ONT at the end user workstation or IP endpoint. The Type II deployment will provide protection of the ONT from tampering, disruption of service, and environmental anomalies such as liquid spills, dust, or even vandalism. Enclosures are also recommended in medical facilities, conference rooms, or common areas to conceal cabling and ensure continuity of operation. All connectivity to the ONT (power, fiber port, Ethernet, analog voice, and RF video) may be contained within the enclosure and end user information outlets can either extend externally from the enclosure to a face plate apparatus, or exit the enclosure via pass through devices. The location of the information outlets is dependent upon end user requirements and whether the enclosure is surface mounted or flush mounted. See Figure 6-2.



**Figure 6-2 Flush mounted ONT enclosure**

### 6-2.8.3 Type 3 Outlet

Type 3 deployments allow for a hybrid approach to passive optical LATB infrastructures. Type 3 deployments are appropriate where existing telecommunications rooms (TR) exist and are not planned to be re-purposed after installation of the PON. Type 3 deployments are also appropriate where a viable copper cabling infrastructure exists and is not in need of a technology refresh. Type 3 systems utilize high-density ONTs (Typically 24 Ethernet ports) which are then patched to the horizontal copper cabling drops as does a legacy system utilizing workgroup switches. Type 3 deployments allow for a migration strategy to fiber-to-the-desktop architectures and can readily accommodate technology refreshes where the legacy workgroup switches must be replaced.

The workstation outlet utilized in a Type 3 architecture consists of standard Category rated copper cabling per Chapter 2 of this UFC. The WAOs in this architecture are commonly in place prior to the upgrade or replacement of the active electronics to POL. A new copper plant is recommended, but not required to provide flexibility in the types of networks patched into the POL or for special sources.

*Note: Reference Chapter 2 of this UFC for additional outlet types and design standards for copper or optical-based interior telecommunication wiring.*

6-2.9 Installation Cabling Distribution System (ICDS) or Backbone Cabling

Provide a minimum telecommunications service to all new facilities consisting of one 25pr copper cable and one 24 strand, single mode (OS1) fiber optic cable through a minimum of two 4 inch (100 mm) ducts. Provide additional cable count in accordance with maximum population and workspace requirements per facility type.

Previously, ICDS requirements for the USMC were included in UFC 3-580-10 and 3-580-02, which have been cancelled or are no longer applicable, respectively. The current requirements are included here, until UFC 3-580-02 is completed.

## APPENDIX A REFERENCES

*Note: The most recent edition of referenced publications applies, unless otherwise specified.*

### **INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)**

C2-2012, National Electrical Safety Code

### **INTERNATIONAL ORGANIZATION FOR STANDARDIZATION AND INTERNATIONAL ELECTROTECHNICAL COMMISSION**

ISO/IEC 11801, Information Technology – Generic Cabling for Customer Premises

ISO/IEC 14763-1, Information Technology – Implementation and Operation of Customer Premises Cabling, Part 1: Administration

ISO/IEC 14763-2, Information Technology – Implementation and Operation of Customer Premises Cabling, Part 2: Planning and Installation

ISO/IEC 14763-3, Information Technology – Implementation and Operation of Customer Premises Cabling, Part 3: Testing of Optical Fiber Cabling

### **NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)**

NFPA 70, National Electrical Code, National Fire Protection Association, Inc.

*Note: The NEC must be effective for new design projects awarded after January 1 of the year following the issuance of a revised edition unless specifically identified otherwise in contract documents*

NFPA 780, Standard for the Installation of Lightning Protection Systems

### **TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)**

TIA-568-C.1, Commercial Building Telecommunications Cabling Standard.

TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

TIA-568-C.3, Optical Fiber Cabling Components Standard.

ANSI/TIA-568-B.2 –1 Addendum 1, Transmission Performance Specifications for 4-pair 100-ohm Category 6 Cabling.

ANSI/TIA-568-B.2–4 Addendum 4, Solderless Connection Reliability Requirements for Copper Connecting Hardware.

ANSI/TIA-568-B.3-1 Addendum 1 – Additional Transmission Performance Specifications for 50/125 Optical Fiber Cables.

TIA-569-C Telecommunications Pathways and Spaces

TIA-570-C, Residential Telecommunications Infrastructure Standard.

TIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.

TIA -526-14-B, Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant.

TIA-606-A, Administrative Standard for the Telecommunications Infrastructure.

TIA J-STD-607-B, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

TIA-758-B Customer-Owned Outside Plant Telecommunications Infrastructure

TIA-862, Building Automation Systems Cabling Standard

TSB-162-A, TIA Systems Bulletin Telecommunications Cabling Guidelines for Wireless Access Points

## **DEPARTMENT OF DEFENSE**

MIL-STD-188-124B, Grounding, Bonding And Shielding for Common Long Haul/Tactical Communication Systems Including Ground Based Communications- Electronics Facilities and Equipments.

MIL-HDBK-419A Grounding, Bonding, and Shielding For Electronic Equipment and Facilities

CNSSAM TEMPEST/1-13 Red/Black Installation Guidance

ICD/ICS 705 (U) Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities

ICS 705-1 Physical and Technical Security Standards for Sensitive Compartmented Information Facilities

ICS 705-2 Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information

MCO 5530.14A Marine Corps Physical Security Program Manual

NSTISSP 300 (U) National Policy on Control of Compromising Emanations

UFC 1-300-01 Criteria Format Standard

UFC 3-580-10 Navy and Marine Corps Intranet (NMCI) Standard Construction Practices



UFGS-27-10-00 Building Telecommunications Cabling System

UFC 1-200-01 General Building Requirements

UFC 4-010-05 Sensitive Compartmented Information Facilities Planning, Design, and Construction  
MIL-HDBK-1012/3 Telecommunications Premises Distribution Planning, Design, and Estimating

ETL 02-12 Communications and Information System Criteria for Air Force Facilities

I3A Army Installation Information Infrastructure Architecture

## GLOSSARY

### Abbreviations and Acronyms:

<b>10G</b>	10-Gigabit Ethernet
<b>10GPON</b>	10-Gigabit Symmetrical Passive Optical Network
<b>AC</b>	Alternating Current
<b>ADN</b>	Area Distribution Node
<b>AFCESA</b>	Air Force Civil Engineering Support Agency
<b>AFH</b>	Army Family Housing
<b>AHJ</b>	Authority Having Jurisdiction
<b>ANSI</b>	American National Standards Institute
<b>APC</b>	Angled Physical Contact
<b>A/V</b>	Audio Visual
<b>AWG</b>	American Wire Gauge
<b>BATB</b>	Base Area Transport Boundary
<b>BEQ</b>	Bachelor Enlisted Quarters
<b>BET</b>	Building Entrance Terminal
<b>BICSI</b>	Building Industry Consulting Service, International, Inc.
<b>BOQ</b>	Bachelor Officers Quarters
<b>CATV</b>	Community Antenna or Cable Television
<b>CCB</b>	Construction Criteria Base
<b>CCTV</b>	Closed-Circuit Television
<b>CP</b>	Consolidation Point
<b>CTTA</b>	Certified TEMPEST Technical Authority
<b>DAA</b>	Designated Accreditation Authority
<b>dBmV</b>	Decibel (reference to millivolt)
<b>DC</b>	Direct Current
<b>DCO</b>	Dial/Digital Central Office
<b>DDC</b>	Direct Digital Controller
<b>DOIM</b>	Directorate of Information Management
<b>DOIM</b>	Directorate of Information Management
<b>DoD</b>	Department of Defense
<b>DODISS</b>	Department of Defense Index of Specifications and Standards
<b>DPW</b>	Directorate of Public Works
<b>EES</b>	Earth Electrode Subsystem
<b>EF</b>	Entrance Facility
<b>EMT</b>	Electrical Metallic Tubing
<b>ER</b>	Equipment Room
<b>EUB</b>	End User Building
<b>FO</b>	Fiber Optic
<b>FOCIS</b>	Fiber Optic Connector Intermateability Standard
<b>FOPP</b>	Fiber Optic Patch Panel
<b>FOUO</b>	For Official Use Only
<b>Gbe</b>	Gigabit Ethernet
<b>GE</b>	Grounding Equalizer
<b>GHz</b>	Gigahertz

<b>GPON</b>	Gigabit Passive Optical Network
<b>HVAC</b>	Heating, Ventilation and Air Conditioning
<b>I3A</b>	Installation Information Infrastructure Architecture
<b>ICDS</b>	Installation Communications Distribution System(s)
<b>IDF</b>	Intermediate Distribution Frame
<b>IMA</b>	Information Mission Area
<b>IS</b>	Information System
<b>ISP</b>	Inside Plant Wiring
<b>ITS</b>	Information Transport System
<b>ITU</b>	International Telecommunications Union
<b>LAN</b>	Local Area Network
<b>LATB</b>	Local Area Transport Boundary(s)
<b>LC</b>	Lucent Connector
<b>MCEN</b>	Marine Corps Enterprise Network
<b>MCN</b>	Main Core Node
<b>MDF</b>	Main Distribution Frame
<b>MHz</b>	Megahertz
<b>MILCON</b>	Military Construction
<b>MRI</b>	Magnetic Resonance Imaging
<b>MTBF</b>	Mean Time Between Failures
<b>MUTOA</b>	Multi-User Telecommunication Outlet Assembly
<b>NAVFAC</b>	Naval Facilities Engineering Command
<b>NCTAMS</b>	Naval Computer and Telecommunications Area Master Station
<b>NEC</b>	National Electrical Code
<b>NESC</b>	National Electrical Safety Code
<b>NFPA</b>	National Fire Protection Association, Inc.
<b>NGEN</b>	Next Generation Enterprise Network
<b>NMCI</b>	Navy and Marine Corps Intranet
<b>NSI</b>	National Security Information
<b>ODN</b>	Optical Distribution Network
<b>OLT</b>	Optical Line Terminal
<b>ONT</b>	Optical Network Terminal
<b>OSP</b>	Outside Plant
<b>PDS</b>	Protected Distribution System
<b>PET</b>	Protected Entrance Terminal (sometimes referred to as BET)
<b>POL</b>	Passive Optical LAN
<b>PON</b>	Passive Optical Network
<b>POTS</b>	Plain Old Telephone Service
<b>RCDD</b>	Registered Communications Distribution Designer
<b>RU</b>	Rack Unit
<b>SEBQ</b>	Senior Enlisted Bachelor Quarters
<b>SFP</b>	Small Form Pluggable
<b>SIPRNET</b>	Secret Internet Protocol Router Network
<b>SMF</b>	Single Mode Fiber
<b>TBB</b>	Telecommunications Bonding Backbone
<b>TDMM</b>	BICSI Telecommunications Distribution Methods Manual (Latest Edition)
<b>TE</b>	Telecommunications Enclosure
<b>TEF</b>	Telecommunications Entrance Facility

<b>TGB</b>	Telecommunications Grounding Busbar
<b>TIA</b>	Telecommunications Industry Association
<b>TMGB</b>	Telecommunications Main Grounding Busbar
<b>TR</b>	Telecommunications Room
<b>UCR</b>	Unified Capabilities Requirements (Latest Edition)
<b>UFC</b>	Unified Facilities Criteria
<b>UL</b>	Underwriters Laboratory, Inc.
<b>UPC</b>	Ultra Physical Contact
<b>USACE</b>	United States Army Corps of Engineers
<b>UTP</b>	Unshielded Twisted Pair
<b>VTC</b>	Video Teleconference
<b>WAO</b>	Work Area Outlet
<b>WAP</b>	Wireless Access Point

### Terms

**Intra-Building Backbone** – Connectivity for the voice, video, and data networks between the entrance facility or equipment room, to a telecommunications room.

**Inter-Building Backbone** - Connectivity between buildings, also referred to as part of Outside Plant (OSP) and will be defined in UFC 3-580-02